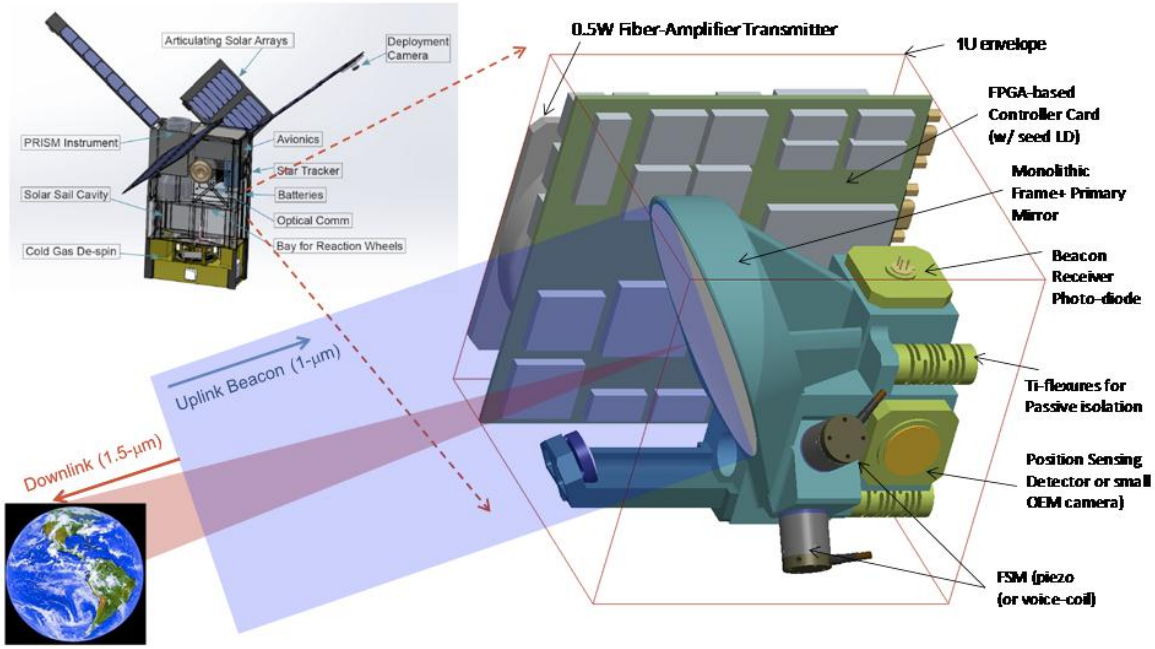
1U Cubesat Lasercom Terminal for Deep Space Communication

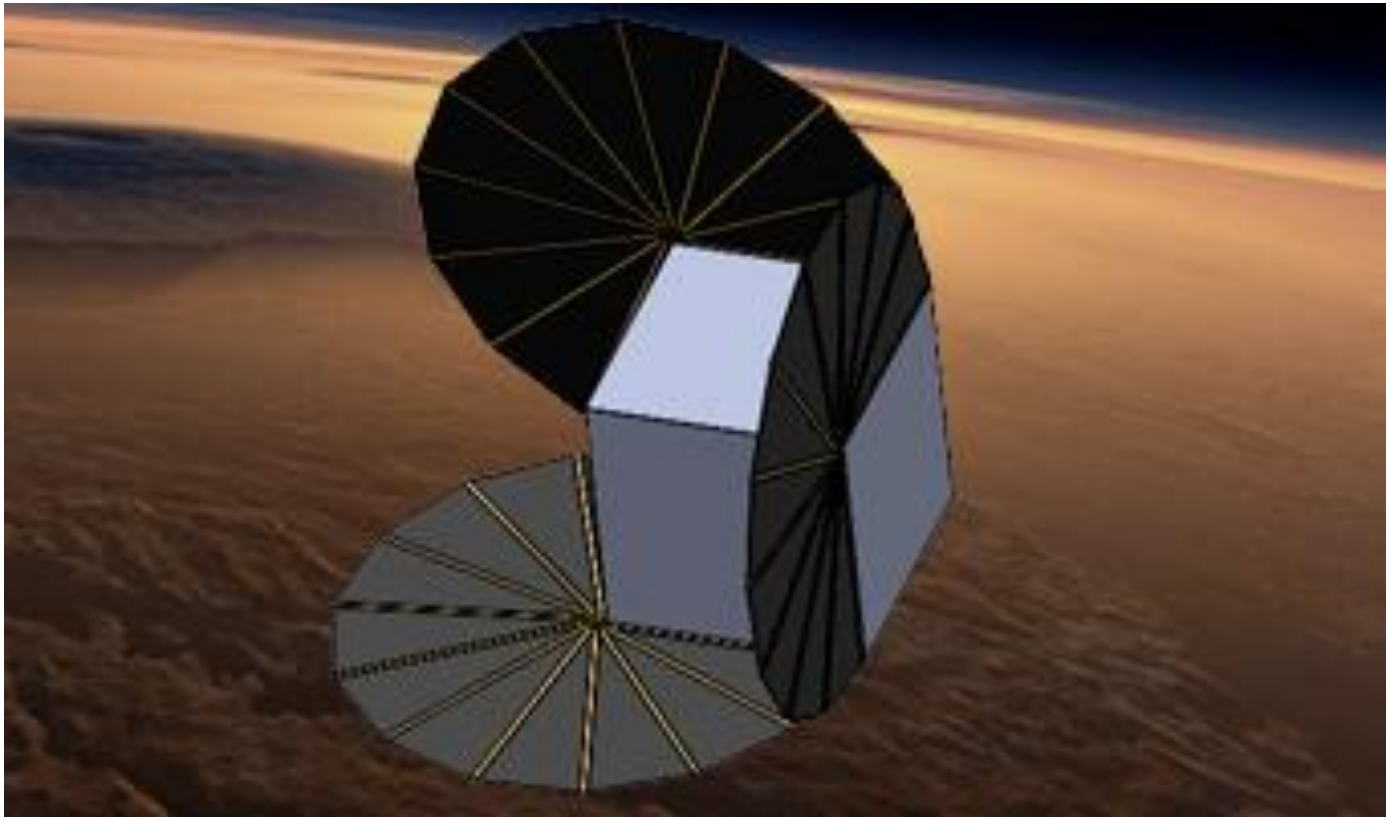
Fibertek, Inc. - Herndon, VA

Fibertek, proposes the design, optimization, and analysis of a 1U cubesat laser communications optical terminal, optimized for deep-space communication links, targeting the following characteristics: (i) low size/weight/power design for deep-space mission (the total power budget target is less than 5W), (ii) a thermalized optical design of a fiber-coupled optical telescope for laser communication transmit/receive function, (iii) innovative monolithic design and fabrication of optical assembly with large 6.5-cm aperture, (iv) integrated beam point-ahead and beam-pointing stabilization, (v) Integrated radiation-tolerant FPGA-based controller card for all control and interface functions for this 1U cubesat terminal, and (vi) use of integrated simulation & modeling tools (optical, thermal, vibration, jitter-control, etc.) for detailed design analysis to assist in future hardware-in-the-loop testing of critical functions to validate performance, prior to prototype build and test.



Deployable Solar Energy Generators for Deep Space Cubesats
Nanohmics, Inc. - Austin, TX

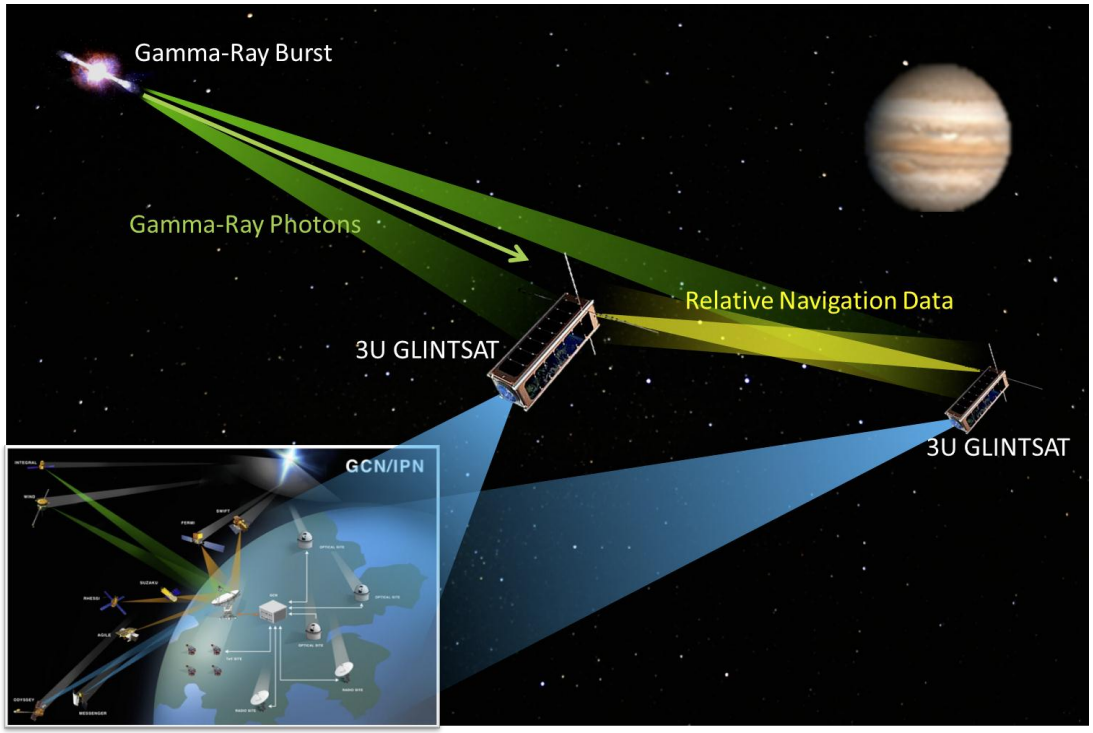
Nanohmics Inc. proposes to develop and test a compact, high efficiency solar thermoelectric generator. The technology is amenable to mass manufacturing and is based on recent development successes at Nanohmics: thermoelectrics development and coatings to maximize emissivity. On a space vehicle, the energy generator would be deployable in a number of ways including a folding fan-like unpacking or other compact designs.



Deep Space Cubesat Gamma-ray Navigation Technology Demonstration

ASTER Labs, Inc. - Shoreview, MN

- Novel enabling technology for interplanetary cubesat navigation
- Utilizes celestial gamma-ray bursts observed by two cubesats to obtain relative navigation solution
- Integrates dual purpose high resolution gamma-ray monitor for science experiments and navigation use
- Develops and implements advanced timing circuit board capable of ns-level timing into a NASA cubesat demonstrator mission
- Independent 3-D spacecraft position determination anywhere in solar system
- Current (DSN): ~50 km Proposed system: < 1 km (one-sigma)
- Builds upon and extends XNAV+XTIM innovations (NASA & DARPA), GLINT (NASA) and HASP research concepts



Cubesat Ambipolar Thruster for LEO and Deep Space Missions

Aether Industries, LLC - Ann Arbor, MI

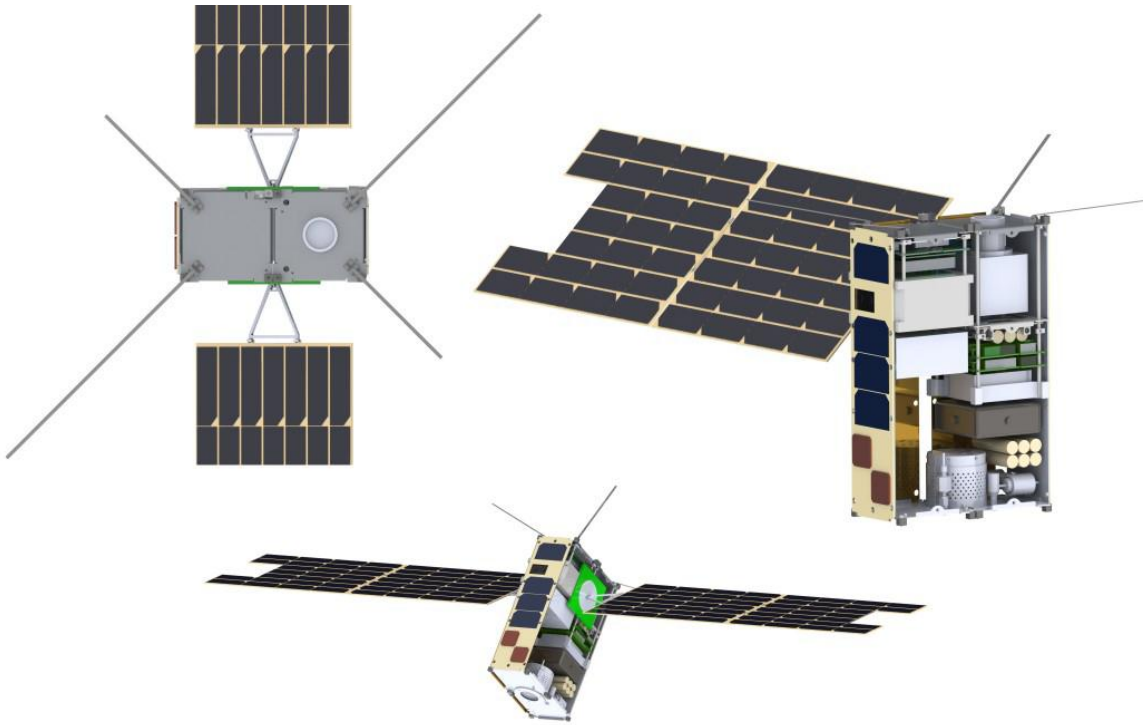
The Cubesat Ambipolar Thruster (CAT) is a novel, micro- electric propulsion system that provides cubesats with enhanced propulsive capabilities with an improvement of 10 to 100 times beyond state-of-the-art capabilities. In CAT, a high density RF plasma discharge expands adiabatically along a magnetic nozzle topology established by permanent magnets. The resulting performance benefits include:

- High Isp (1000-2500 s) and delta-V (1 to 10 km/s).
- High thrust (10 mN) and thruster efficiency (50%).
- Compatibility with cubesats (1 kg & 3 to 100 W).
- Flexible propellant usage (both gas & liquid).
- Usable with green liquid propellants (e.g., H2O).
- No need for a separate neutralizer or high voltage components.

LunarCube for Deep Space Missions

Busek Company Inc. - Natick, MA

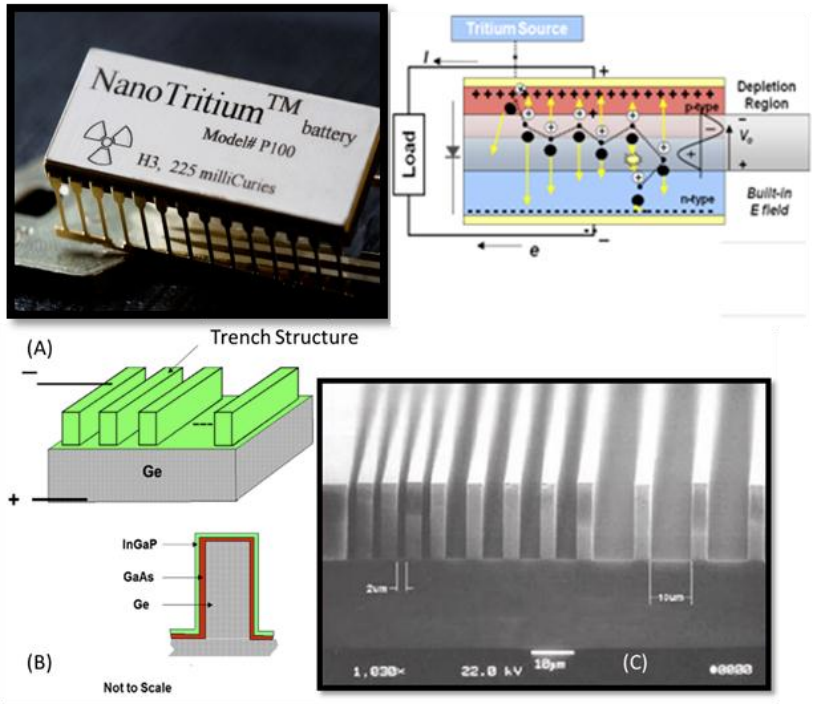
Busek Company, Inc. and Morehead State University propose to develop a 6U cubesat capable of reaching a lunar orbit from geo-synchronous orbit. The primary objective is to demonstrate heretofore unavailable high Isp (~3000s) with a small and very efficient ion thruster. A mission to the moon will demonstrate a propulsion technology that enables a variety of other deep space missions. Unlike the well-known and much larger direct current ion thrusters flown on missions such as Deep Space 1 and Dawn, the proposed thruster is powered by an inductively coupled RF discharge with condensable propellant. An additional objective is to demonstrate that much of the spacecraft electronics, primarily the control and data handling portion, can be based on low-cost components and survive the deep space environment. The mission will also require a pioneering approach to power generation delivering peak power of about 96 Watts.



High Power Betavoltaic Technology

MicroLink Devices, Inc. - Niles, IL

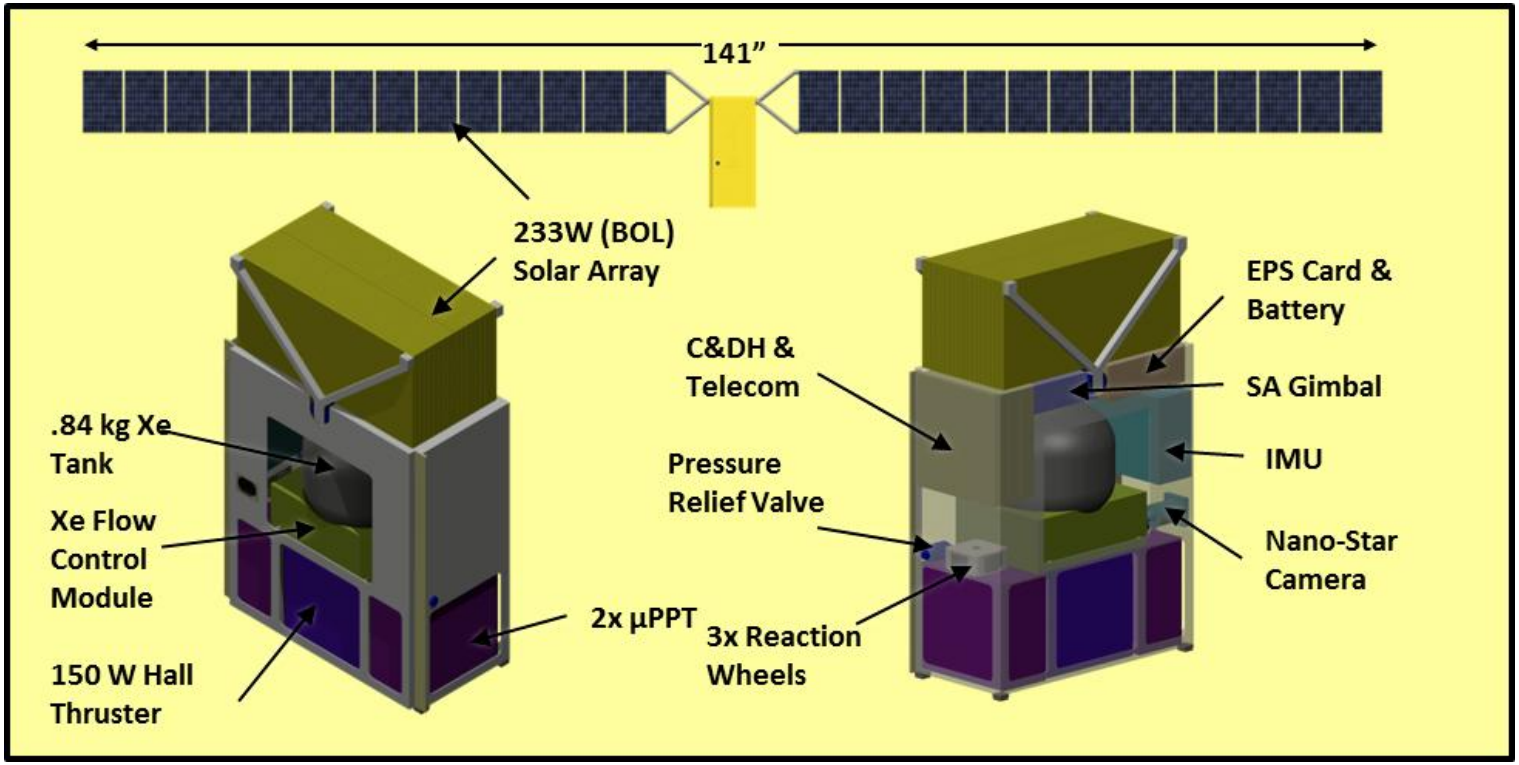
The proposed innovation will dramatically improve the performance of tritium-powered betavoltaic batteries through the development of a high-aspect-ratio, expanded-surface-area p/n junction composed of indium gallium phosphide. The enhanced surface area features will be built using reactive ion etch modified germanium substrates via metal-organic chemical vapor deposition. The proposed 3-dimensional betavoltaic p/n junction will provide a cost saving of up to 90 percent, while increasing energy density to up to ten times that of lithium batteries. Such an advanced semiconductor device will produce much higher power outputs than are possible with existing state-of-the-art devices. It will provide the battery a life span in excess of 20 years with the broad-range temperature-insensitivity benefits normally associated with betavoltaics.



Solar Electric Propulsion Cubesat Bus for Deep Space Missions

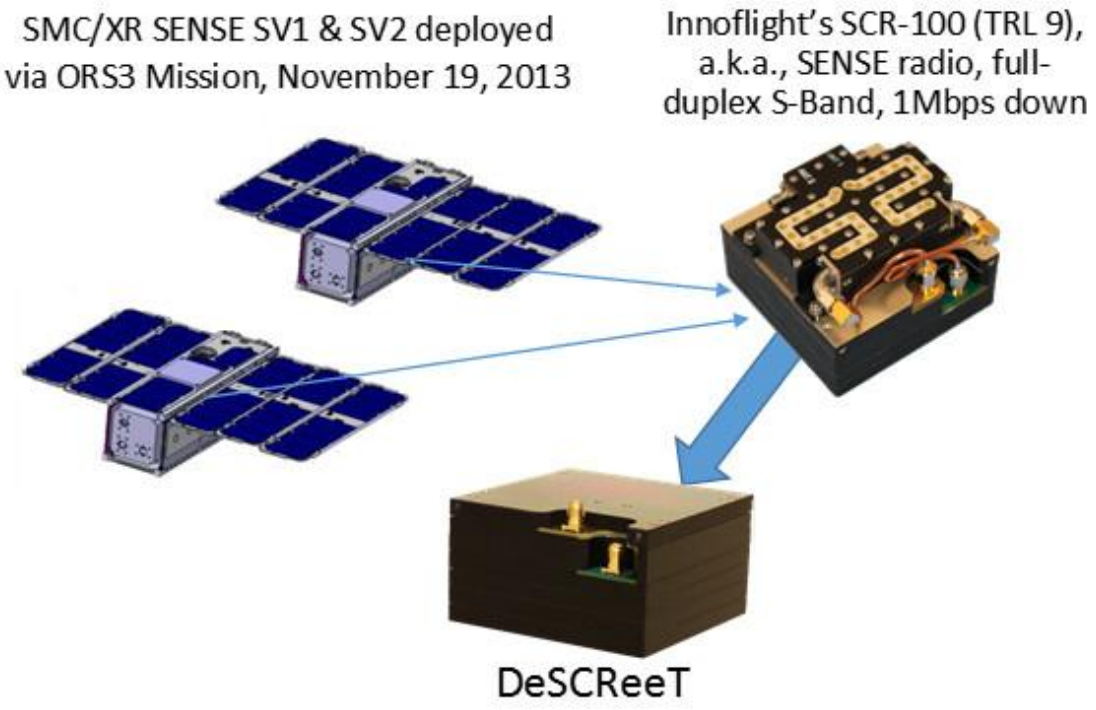
ExoTerra Resource LLC - Lone Tree, CO

ExoTerra's solar electric propulsion cubesat bus enables the first cubesat-scale propulsion system capable of delivering over 1 km/sec of delta-velocity. Key innovations include a solar array deployment scheme that triples the available power for cubesats, a direct drive power distribution system to eliminate heavy and expensive power processing units, and a low-power, high specific impulse Hall Effect thruster to propel the vehicle. The system design of the bus includes radiation-tolerant electronics, integrated thermal management and guidance systems to enable a deep space mission. The project is intended to build, qualify and then fly the system on a 2017 Space Launch System flight opportunity to demonstrate the first lunar orbit insertion by a cubesat.



Deep Space Cubesat Regenerative Ranging Transponder
Innoflight, Inc. - San Diego, CA

Innoflight proposes developing a 0.5U Deep Space Cubesat Regenerative Ranging Transponder (DeSCReeT) compatible with NASA's Deep Space Network and similarly capable ground assets and with flight-ready units available for cubesats deployed in cis-lunar space via the EM1 mission. The transponder will leverage Innoflight's flight-heritage, software-defined compact radio (SCR) family. Phase 1 design efforts include requirements gathering from Pre-Phase A and Phase A cubesat missions, forward error correction trades, X-band versus S-band trades, and radiation-tolerant component trades. The Phase 1 effort will successfully complete a CDR-level design by the end of the period of performance.



Multi-Purpose Interplanetary Deployable Aerocapture System
Altius Space Machines, Inc. - Louisville, CO

The Multipurpose Interplanetary Deployable Aerocapture System (MIDAS) provides aerocapture, power generation, deep-space spacecraft-to-Earth groundlink communications, and radiation shielding. The system consists of a deployable magnetoshell aerocapture (MAC) electromagnet coil deployed by composite storable tubular extendable member (STEM) booms, roll-out solar arrays integrated with the STEM booms, a Loop Yagi antenna that reuses the MAC coil as the reflector and uses a separate deployed-driven loop, and the MAC battery and RF plasma generator system. MIDAS provides:

- Compact stowability: fitting into 2-3U for a 6U cubesat.
- Dynamic aerocapture/braking
- High system power: even providing useful power at Jupiter distances
- Burst-mode spacecraft-to-Earth communication
- Spacecraft radiation shielding: providing protection against solar flares and planetary radiation belts.